MOTOROLA
FUZZY LOGIC EDUCATIONAL KIT
Installation Procedure

Minimum computer configuration

- PC/AT™ -class or compatible (386 recommended) with one floppy drive
- 640 KB conventional memory
- 1MB extended memory
- 10MB free hard disk space during installation
- 5.5MB of disk space after installation is complete
- DOS™ 3.30 (5.0 recommended) with Windows™ 3.0 or 3.1 (in Protected mode) with standard VGA fonts
- VGA color monitor and mouse

Installation procedure

Some files on the diskettes are compressed and require the installation program in order to be uncompressed and combined for proper operation.

To install the educational course, start Windows and insert disk #1 into the floppy disk drive. Then run the INSTALL.EXE program on disk #1 by selecting the Run option from File menu and typing the following path convention on the command line:

[DRIVE]:\INSTALL.EXE

The installation procedure will create a Program Group and its icon in Windows and will allow the user to select his or her own directory.

To run the program from within Windows without using the icon, select File+Run from Program Manager and use the following convention on the command line:

[DRIVE]:\[DIRECTORY]\TBOOK.EXE FUZZY.TBK

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Project & Freeware Disk Information

The information presented here describes the project required to enter the contest, and the software enclosed in the Freeware Disk. It explains what is involved in the project sections and how the score for the project will be calculated. It also addresses the BBS software (HC11 and HC05 kernels and Knowledge Base Generator) included on the disk.

THE PROJECT

The final score received will be based on a multiple choice test worth 45 points and on the design of an anti-lock braking (ABS) system worth 55 points (45 points possible for performance and 10 points for memory usage). Six extra credit points can be obtained for short essays written on fuzzy logic. Each of these will be described next in more detail.

A- The written test:

The test is made up of 45 multiple choice questions each worth one point. It is enclosed with the educational kit materials along with a separate answer sheet. When finished, return the test answer sheet in the self-mailer package provided along with a disk containing the ABS FIL file, the essays, the contest entry form, and the course evaluation.

B- The ABS project:

The educational course describes in detail the background information necessary to design an ABS. After the demo version of FIDE has been installed on the computer, you must load FIDE with the files required to run the automobile simulator. These files are enclosed in the Freeware disk in a sub-directory called ABS which needs to be copied to a directory called EXAMPLES in the FIDE application. To do this follow these steps:

1- From the hard drive's main directory the DOS prompt should be [DRIVE]:\>
2- Type CD FIDEDEMO\EXAMPLES at the prompt to move into the EXAMPLES directory. The prompt will now be [DRIVE]:\FIDEDEMO\EXAMPLES>
3- Type MD ABS to create a directory called ABS
4- Type CD ABS to move to the ABS directory created
5- Insert the Feeware disk into the floppy disk drive and type COPY [DRIVE]:\ABS*.* to copy all ABS files from the disk.

At this point you are ready to run FIDE and begin the design of the fuzzy logic ABS. MAKE SURE TO FOLLOW THE INSTRUCTIONS PRESENTED IN THE EDUCATIONAL COURSE AND TO SAVE THE FIL FILE TO THE ABS

DIRECTORY. Should any problems arise while running the ABS programs please call Aptronix at (408)428-1888 for help.

The ABS you designed (rules and membership functions) will be tested on the same car simulator used in FIDE for 10 different conditions of initial speed and road conditions. These 10 conditions will be the same for all entries and represent a variety of typical road conditions. Each of the 10 tests will be given a score of

$$S/D$$

where S is zero if the car fails to stop (grades lower than 0) or spins out of control (S is one otherwise). D is the stopping distance.

The total points for performance (45 maximum) will be determined by adding the 10 scores for each test condition and normalizing this score by the highest score from among all the entries received (that is, the ABS design with the highest overall score will receive 45 points and all others will be graded accordingly).

The size of the knowledge base (rules and membership functions) will also be considered. The score for memory usage is determined by

$$1/(A+C+M)$$

where A is the total number of antecedents used, C is the total number of consequents used, and M is the total number of membership functions used. For example, the rule 'IF TEMPERATURE IS HOT AND LOAD IS HEAVY THEN FAN IS HIGH AND TORQUE IS NEGATIVE' has A=2 and C=2.

The total points for memory usage (10 maximum) will be determined by taking the score calculated and normalizing it by the highest score from among all the entries received (that is, the ABS design with the least memory used will receive 10 points and all others will be graded accordingly). ABS models where the sum of S values is less than 6 will not be considered for this calculation.

When finished, return a disk containing the ABS FIL file in the self-mailer package provided along with the test answer sheet, the essays, the contest entry form, and the course evaluation.

C- The essays:

Extra credit will be given for up to two essays (up to 500 words each) for a possible of six extra points (3 per essay). For the first essay choose an application for fuzzy logic control and elaborate on its implementation. The second essay must be on an adaptable fuzzy logic application. The applications need not be the same for the two essay topics. The essays are not to exceed 500 words or they will be disqualified (up to 5 diagrams can be included). Both essays will be judged according to the following criteria:

-Is the application feasible?
-Is the application original?
-Is the design method clear and concise?
-Does fuzzy logic improve time to market?
-Does fuzzy logic provide improved performance?
-Does fuzzy logic make the controller more intelligent?

Finally, return the essays in the self-mailer package provided along with the disk containing the ABS FIL file, the test answer sheet, the contest entry form, and the course evaluation.

Good Luck!!

THE BBS SOFTWARE

The Freeware disk also contains three directories containing the kernels implementing fuzzy logic for Motorola micro controllers along with the Knowledge Base Generator (KBG). Sub-directory HC05 contains the files for the 68HC05 micro controller and directory HC11 does the same for the 68HC11. Sub-directory KBG contains the Knowledge Base Generator along with an example file of an inverted pendulum application (it also contains a file called egavga.bgi for properly running the graphics required by the KBG program).

It is of advantage to periodically check the Freeware BBS for the most recent versions to these programs or for new software available. For example, on July 13, 1992, the BBS will update its EVM05 and EVM11 software to allow users to directly modify the membership functions on the EVM's memory.

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Contest Rules & Regulations

All entries must be postmarked by midnight October 17, 1992.

The original entry form must be signed and returned to constitute a valid entry.

One entry per person. If more than one entry per person is received, only the first entry encountered will be judged.

The fuzzy logic seminar will be held in Hawaii January 18, 19, and 20, 1993.

Motorola will inform winners by November 23, 1992. Winners must confirm their eligibility to attend the seminar by December 4, 1992.

If your score qualifies you to go to attend the seminar in Hawaii and conflict prohibits your attendance, no consolation prize or cash equivalent will be awarded and another winner will be selected. A total of 10 winners will be awarded an expense-paid trip to attend the fuzzy logic seminar in Hawaii. Winners may bring one guest. Motorola will pay for 1) airfare to and from Hawaii (ticket restrictions may apply 2) food and lodging during the seminar 3) transportation to and from the seminar sight while in Hawaii.

This contest is open to any individual or team. The team member to be awarded the trip to Hawaii should be designated on the entry form.

Employees and representatives of Motorola and their immediate families are prohibited from entering this contest.

Motorola retains the right to reproduce, publish, and distribute all submitted materials whether in their original or edited form. All entries become the property of Motorola. Winners agree to permit publicity involving their designs and persons.

All taxes are the responsibility of the winners.

Offer valid in the USA and Canada only.

Void where prohibited by law.

MOTOROLA INC.

Dear Reader:

Every great once and a while a truly offensive weapon is developed which enables you to compete more effectively in your application arena.

Fuzzy logic is such an offensive weapon. As you review this topic, keep in mind how this technology can impact your product lineup. Motorola has long strived to bring you an appropriate line of microcontroller products to optimize the price, size, and performance of your end products. Fuzzy logic achieves this goal by allowing you to add powerful new features to your products without the added cost associated with an enhanced computation engine. This is accomplished by stating the desired behavior of the system with simple "if-then" rules rather than computing the physical basis for that behavior.

Typically, a few rules can replace many lines of conventional code. This permits a significant reduction of development time which could allow you to make that trade show or market introduction window that you might have missed otherwise.

Fuzzy logic also deals naturally with nonlinear systems. If your conventional alternative is to depend on linear models, fuzzy logic might make your life a lot easier.

Since fuzzy logic can be executed using only a few hundred bytes of code, virtually any standard Motorola microcontroller can become a fuzzy MCU. In that vein, Motorola has an existing portfolio of over 100 fuzzy MCUs ready to serve your fuzzy logic needs. If your application requires hardware enhancements for speed, we're developing a variety of options which will provide a natural migration path.

Enclosed, you will find a comprehensive training course. It is designed to give you the fundamental knowledge, heuristic insight and appropriate tools to apply fuzzy logic today.

This technology is *absolutely* not standing still. Natural extensions such as adaptive fuzzy logic and neural networks lie ahead. If you would like to learn more about these extensions, note your interest on the survey form enclosed. If sufficient interest is generated, we will make an advanced course available later this year.

Thank you for taking this first step to learn about an important tool to add to your intellectual portfolio. I wish you a rewarding educational experience.

Best regards,

Steve Marsh
Director, Strategic Operations
Advanced Microcontroller Division

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